Development of a disposable, selective, and sensitive electrochemical sensor for on-site detection of plant viroids

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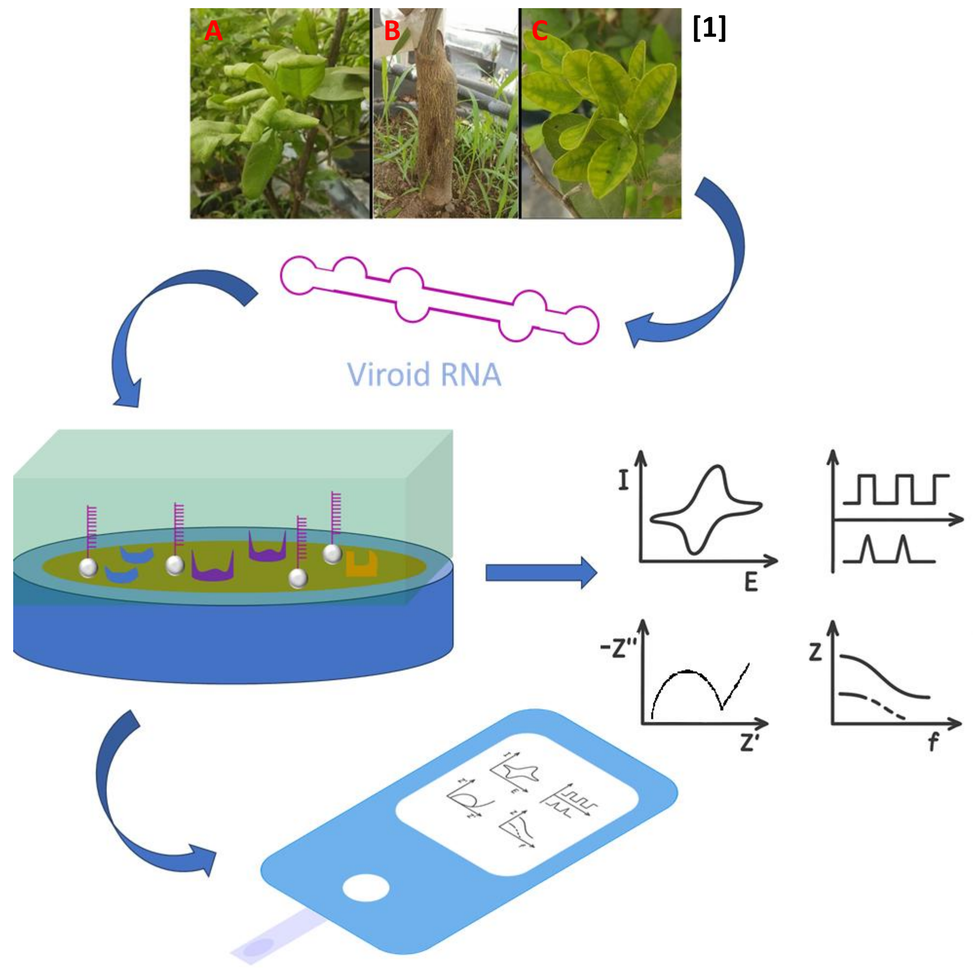
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Background

- Plant viroids: small**, non-coding RNA** pathogens.
- Example**: CBCVd** → symptomless early infection → **yield loss & spread.**
- Current diagnostics: time-consuming, lab-based.
- Need: **Rapid**, **selective**, **sensitive, on-site detection** tool.

Objectives

- Develop a **sensitive** and **selective electrochemical (bio)sensor.**
- Enable **early detection** of CBCVd in field conditions.
- Design a **portable**, **disposable** device, adaptable to screen-printed electrodes.



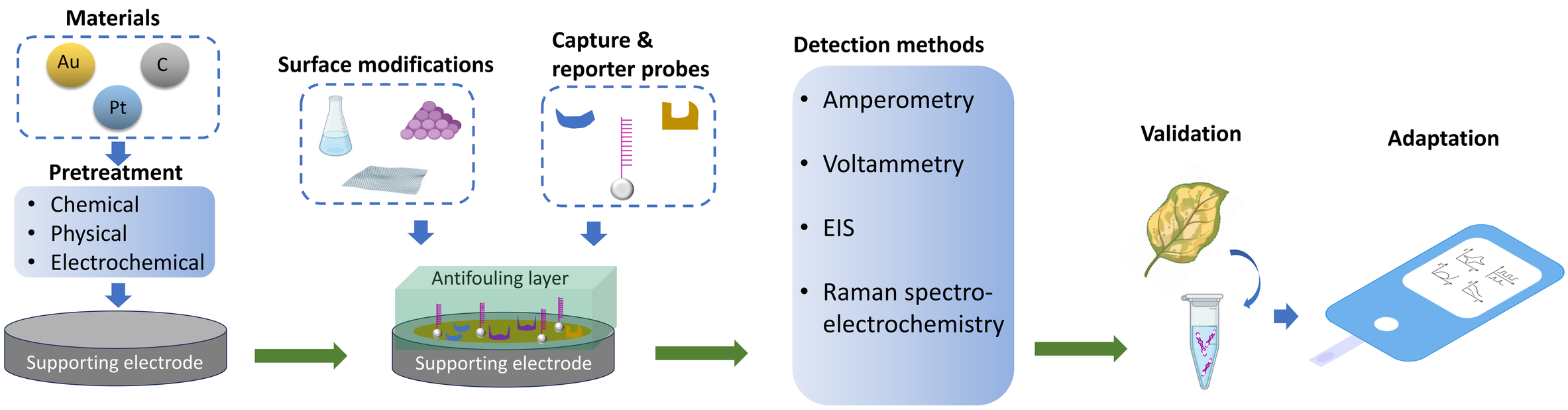
Methods / Work plan

1: **Electrode selection & pretreatment:** Compare electrode materials (carbon, Au, Pt, etc.). Pretreat for reproducibility & surface chemistry.

2: **Electrode modification:** Introduce (nano)structures such as carbon nanotubes, MXenes, metal oxides, and their hybrid composites with polymers, etc. Immobilize DNA/RNA capture probes. Apply antifouling layers such as BSA, Tween 20, etc.

3: **Detection methods:** Explore amperometry, voltammetry, electrochemical impedance spectroscopy, Raman spectroelectrochemistry. Optional amplification: secondary (reporter) probes, redox mediator layers.

4: **Validation & Adaptation:** Test in simulated & real plant samples. Transfer to screen-printed electrode format, including a negative control electrode unit.



Expected Outcomes

- A **robust, field-deployable biosensor**.
- High **sensitivity & selectivity** for CBCVd.
- **Portable, disposable, cost-effective** device.
- Contribution to **precision agriculture & crop protection**.

Future Perspectives

- Expand to detection of other viroids or RNA pathogens.
- Integrate into handheld diagnostic devices.

Reference

[1] Inspected citrus trees showing (A) leaf epinasty on Pomelo, (B) bark cankers on Clementine, and (C) leaf discoloration on Lemon. Reproduced from Abualrob *et al.* (2024), *Sci Rep* 14:423, under a CC BY 4.0 licence. DOI: 10.1038/s41598-023-50271-5.

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